Avifaunal Diversity Mapping and Habitat Conservation Management in the Taj Trapezium Zone (TTZ)

A

SYNOPSIS

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Submitted By

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Introduction

Biodiversity is the sum of diversity and the variety of life forms present in an area or a place. It can be measured at smaller scale like a pond and at larger scale like whole world. Biodiversity varies according to location of the area on the earth. Because of the hot climate and high level of primary productivity, the terrestrial biodiversity is highest at the equator and goes down towards the poles. Thus, the communities which are present at lower latitude have a greater number of species than the communities which are present at higher latitude. Mainly the factors like temperature, precipitation, altitude affect the diversity of the biota.

Mass extinction is the sudden decrease in the number of species on earth which is an outcome of intense change in the environment. It is estimation that 99.9% of over 5 billion life forms that ever existed, are on the verge of extinction. Estimated number of species which are currently present in the world range from 10 million to 14 million and only 1.74 million have been documented out of them. In the world, seventeen countries are declared as mega-diverse countries, India is being one of them. India is located on the high diversity zone of the earth. Some of the richest diversity zones of the world are located in India. Biodiversity Hot-spot is a bio-geographical area, where the biodiversity level is high, human threat is high, endemism is high. Out of 35 world's biodiversity hot-spots India houses four hot-spots of them, the Himalayas, the Indo-Burma region, the Western Ghats and the Sundarbans India has 2,546 species of fish, 240 species of amphibians, 460 species of reptiles, 1,232 species of Aves and 397 species of mammals.

Birds are warm blooded animals, characterized by feathers, beak, and light weight skeleton. In classification they belong to the class Aves. Strategies in India for conservation of biodiversity rich areas are to give them special status as national parks, biosphere reserves and wildlife sanctuaries. Habitat destruction, pollution, introduction of alien species etc. are the major threats to the biodiversity of these, Habitat destruction is mainly responsible for biodiversity depletion.

Taj Trapezium Zone (TTZ) is the zone around the Taj Mahal which covers an area of about 10,400 km^2. It covers the area in the shape of trapezoid between 26° 45N & 77 ° 15E to 27 ° 45N & 77° 15E in the West of the Taj Mahal and in the East of Taj Mahal between 27° 00N & 78° 30E to 27° 30N & 78°30E. Mainly six districts from the states of Uttar Pradesh and Rajasthan come under this zone -

Bharatpur from Rajasthan and Agra, Mathura, Firozabad, Etah, Hathras from Uttar Pradesh. This area is of immense importance with respect to migratory birds. In winters, many migratory birds migrate to this area for shelter and food. Some important sites found in this zone are Keoladeo National Park in Bharatpur, Sur Sarovar bird sanctuary in Agra, Patna bird sanctuary in Etah. The habitat of TTZ is semi-arid type, it means this area receives 10 to 20 inches rain per year. Temperature in TTZ ranges from 5^0 C to 50^0 C. Average rainfalls in monsoon is 628.6 mm.

Biodiversity has been a topic of interest since the time of Moghuls. Babur, the first emperor of Moghuls has drawn his interest about geography and migratory patterns of migratory birds in his famous work Baburnama. He mentioned many animals, birds, plants of that period of time. Animal hunting was the tradition in Indian culture, but Akbar began to end this hunting culture. Jahangir, started to painting the pictures of flowers and animals.

New technologies such as remote sensing and Geographical Information System are very useful in the field of biodiversity conservation and management. Remote sensing is the tool by which we can acquire the information about the earth surface, topography, vegetation etc. without having to physical examine it. Remote sensing uses the high-flying aircrafts, satellites etc. to get the details about an area or place. GIS is a computer-based application in which we can store the different kinds data, analyse and present the data in different forms.

To choose this topic there are two main reasons: First is my enthusiasm about wildlife and especially for birds and second is the importance of Taj Trapezium Zone in the route of migratory birds as thousands of migratory birds come here in winter season for wintering, breeding etc. By this research work, I will build the basic inventory of avian biodiversity scientific data and their habitats found in TTZ, hitherto unavailable, and this data will go a long way in making conservation strategies and plans for the sustainability of TTZ.

Review of Literature

Salim Ali 'Birdman of India' was the first Indian to conduct systematic bird survey across India. He created the Ghana bird sanctuary at Bharatpur, which is a very important Ramsar site in Taj Trapezium zone. **Gadgill et al., (1989)** provided an excellent documentation of the bird fauna existed from 1890s to 1980s. The forest habitat destruction and habitat specialists' relationship in the hilly

district of Uttara Kannada was first highlighted by him. Davidson (1898) collected and identified birds and showed their geographical distribution, abundance, commonness and rarity, habitat preference, nesting season and migration. Koelz (1942) collected and identified birds from a small portion of the district, although his list was not as detailed as Davidson's.

Khan et al., (1999) conducted the bird survey from April 1995 to July 1997 in Kumaun Himalayan. They used point count, species richness methods and recorded 232 bird species.

Pamdey (1992) conducted the survey to check the changes in bird diversity due to construction of Pong Dam reservoir. He used One-day water bird count method and surveyed by walking or boating, point count methods.

Jayson et al., (2000) used the total count method to census the bird population in Kole wetland, Thrissur, Kerala. Identification of the birds was done with the help of field guides and reference books (Ali, 1969; Woodcock, 1979; Ali and Ripley, 1983; Kantan et al., 1993; Grimmett et al., 1998; Daniels, 1998).

Raman (2003) compared different bird census methods. He used line transect, point count and territory spot-mapping methods to estimate bird density.

Khera et al., (2009) worked in Delhi green spaces to explore the importance of urban areas in biodiversity conservation. They used point count and accosting monitoring methods to survey and analysed the data for species richness, density and species diversity indices. Pearson's correlation analysis also used to explain the relationship between different variables.

Jha (2012) studied the heronry birds and their breeding and ecological behaviour in Soor sarovar bird sanctuary, Agra. Field guide (Grimmett & Inskipp, 2003) was used for identification and nest count method was used to count breeding population. He used nest height- bird size hypothesis, some species supported his hypothesis and some species not. He gave some recommendation for heronry conservation by his study.

Gupta et al., (2013) focused on isolated Egyptian vulture's eliminating population in Mathura, Palwal, Faridabad region on Agra-Delhi highway. They used random field observation method to survey the area and for identification used reference books (Ali & Ripley, 1987, Grimmet et al., 1998 and Ali, 1996).

Shah et al., (2013) worked on crustacean diversity in Wular lake, Kashmir. In this work they expressed the applications of different diversity indices like Shannon, Simpson, Evenness, Marglef etc. in details.

Ilyas et al., (2015) studied the impact of urbanisation on birds around Aligarh city by applying biodiversity indices such as Shannon-Wiener diversity and Marglef richness they finalized the contribution of urban, rural and forest in total available species. One way ANOVA was used to analyse density of birds among the habitats.

Sharma et al., (2016) worked on declining population of birds in KNP wetland which is an important biodiversity site in TTZ. This study shows the influence of decline water quality in wetland on its bird population and records 23 % declination in bird population as compare to 2007.

Najan et al., (2017) used the satellite data of Land sat was obtained from USGS from the year 1995 to 2017 to study the change in the land cover of Harike wetland and they found the reduction in wetland land cover by the 153.5% growth in agricultural land.

Ramchandran et al., (2017) used RS and GIS to compare forest area and land use pattern in Idduki district of Kerala from 1925 to 2012. In 1925, 93.2% area covered with forest as compare to 52.1% in 2012.

Jhariya et al., (2018) studied the impact of change in land use and land cover on water conservation and management in Raipur city of Chhattisgarh state in India They used remote sensing and GIS to study the land use and land cover changes from 1999 to 2016 and found increase in road, settlement, industries, open land.

Subramani et al., (2018) applied Remote sensing and Geographical Information System to do biodiversity mapping in Trichy district of Kerala, India. In this study, they mainly focused on technical aspects of RS data and GIS software technologies.

District et al., (2018) studied the pat watersheds in district Jhabua of Madhya Pradesh, India by analysing land use and land cover with the help of remote sensing and GIS technologies. Area of this study belongs to the toposheet no. 46I/8, 46I/12, 46J/5 and 46J/9 of survey of India.

Mukopadhyay et al., (2018) Used 25m fixed radius point count method surveyed the area in Gangatic plains in West Bengal and documented the bird diversity according to different habitats. For bird identification they used Ali and Ripley (1987) and Grimmett et al. (2011).

Verma et al., (2018) used high level RS and GIS techniques to do assessment of plant and animal diversity in four bird sanctuaries of Uttar Pradesh included Soor sarovar Bird sanctuary. They used line transect and quadrate method to do survey. They recorded 62 species of birds from Soor sarovar bird sanctuary.

Arya et al., (2019) surveyed the migratory bird populations of natural and manmade wetlands in Haridwar from 2009 to 2018 by using point count method and found that natural wetland habitat had maximum diversity than manmade wetland habitat.

Qadir et al., (2019) studied land use and land cover changes and the impact on Dal Lake water of solid waste by using RS and GIS. They found decrease in agriculture land, forest cover, water bodies, plantation and increase in built land, aquatic vegetation.

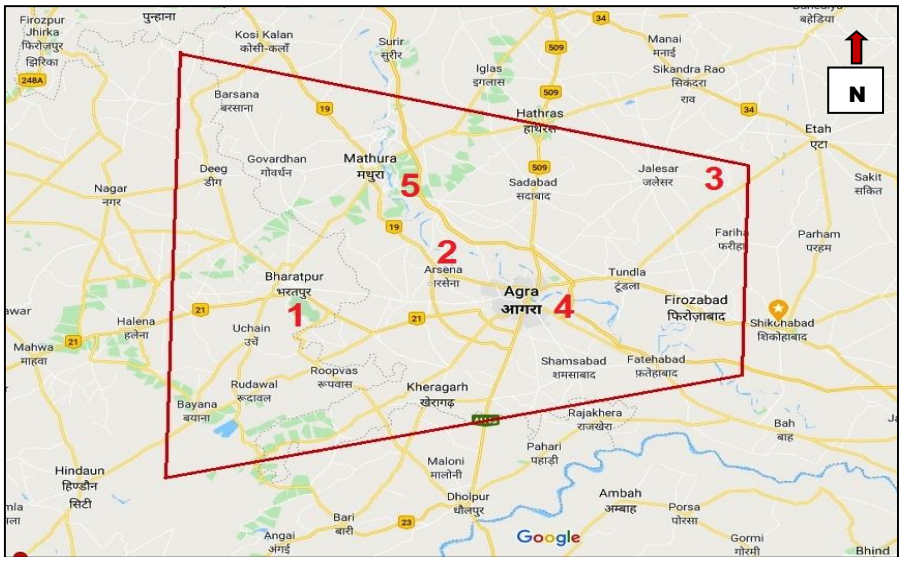
Mishra et al., (2019) used RS and GIS techniques to monitor the changes in land cover and land use in Sikkim Himalayan region for the period of 1988-2017. They found increase in dense forest, water bodies and build up area and found decrease in open forest, barren land and agriculture field.

Objectives

- To survey and identify the potential avian biodiversity hotspots in the protected as well as unprotected areas of TTZ.
- To prepare an inventory of prominent avian faunal groups in every identified hotspot.
- To utilize the remote sensing and GIS methods for habitat assessments.
- To develop avian faunal diversity database for IUCN categorization for endemic, endangered, threatened, vulnerable and abundant species from TTZ.
- To assess the current habitat status and plan for its sustainability and improvement.
- To recommend conservation measures and action plan for stakeholders for the sustainability of the avian fauna in TTZ.

Methodology

Sampling sites:



(Fig 1. Sites under the Taj Trapezium Zone)

- Site 1: Keoladeo National Park, Bharatpur, Rajasthan (Protected)
- Site 2: Soorsarovar Bird Sanctuary, Agra, Uttar Pradesh (Protected)
- Site 3: Patna Bird Sanctuary, Etah, Uttar Pradesh (Protected)
- Site 4: Taj Nature Walk, Agra, Uttar Pradesh (Protected)
- Site 5: Forest Area, Mathura, Uttar Pradesh (Unprotected)

Data collection mode:

- Secondary Information – Research papers, Area authority, discussions with individual experts, reports etc.
- Primary Data Collection - Field survey/sampling, Remote sensing data.
- Photo documentation of the current habitat status.

Field Sampling Techniques:

- **Point Transect:** It is a survey technique, in which observer follows a transect path and record birds at regular intervals for 5 to 10 mins time period. It is suitable for dense habitat such as forest, shrubs etc. It is suitable for shy, cryptic and skulking species.
- **Line Transect:** It is a survey technique, in which observer follows a transect path and record birds continuously without any halt. It is suitable for open and uniform habitats such as wetlands, grassland etc. It is suitable for mobile, large species.

Identification: Identification of the birds will be done with the help of Wildlife Experts from ZSI, WII, WWF, SACON, BNHS and International Crane foundation. IUCN Field Guides and Books will be also utilised books.

Biodiversity measurement:

- **Margalef's richness Index:** It is a measurement of species richness. It has no limit of values. With increase in value, it reflects a greater number of species in the community. It does not consider evenness and dominance. It is sensitive sample size.

$$d = (S-1) / \ln N$$

S= number of taxa

N= total number of individuals

- **Shannon- Wiener Index:** It is introduced by Cloude E. Shannon and Norbert Wiener based on their theories of information. Value of this index remains between 0 to 5. With increase in value, it reflects less polluted environmental conditions in habitat. It determines richness and evenness both.

$$H' = -\Sigma [(ni / N) \times (\ln ni / N)]$$

ni= total individuals of ith species

N= total individuals of all species

- **Simpson's Index of diversity:** It is published first in 1949 by Edward H. Simpson. Value of this index ranges from 0 to 1.0 value of this index reflects the highest dominance and 1 reflects the highest evenness in the community.

$$D = 1 - \frac{\sum [ni (ni- 1)]}{N (N-I)}$$

ni= total individuals of ith species

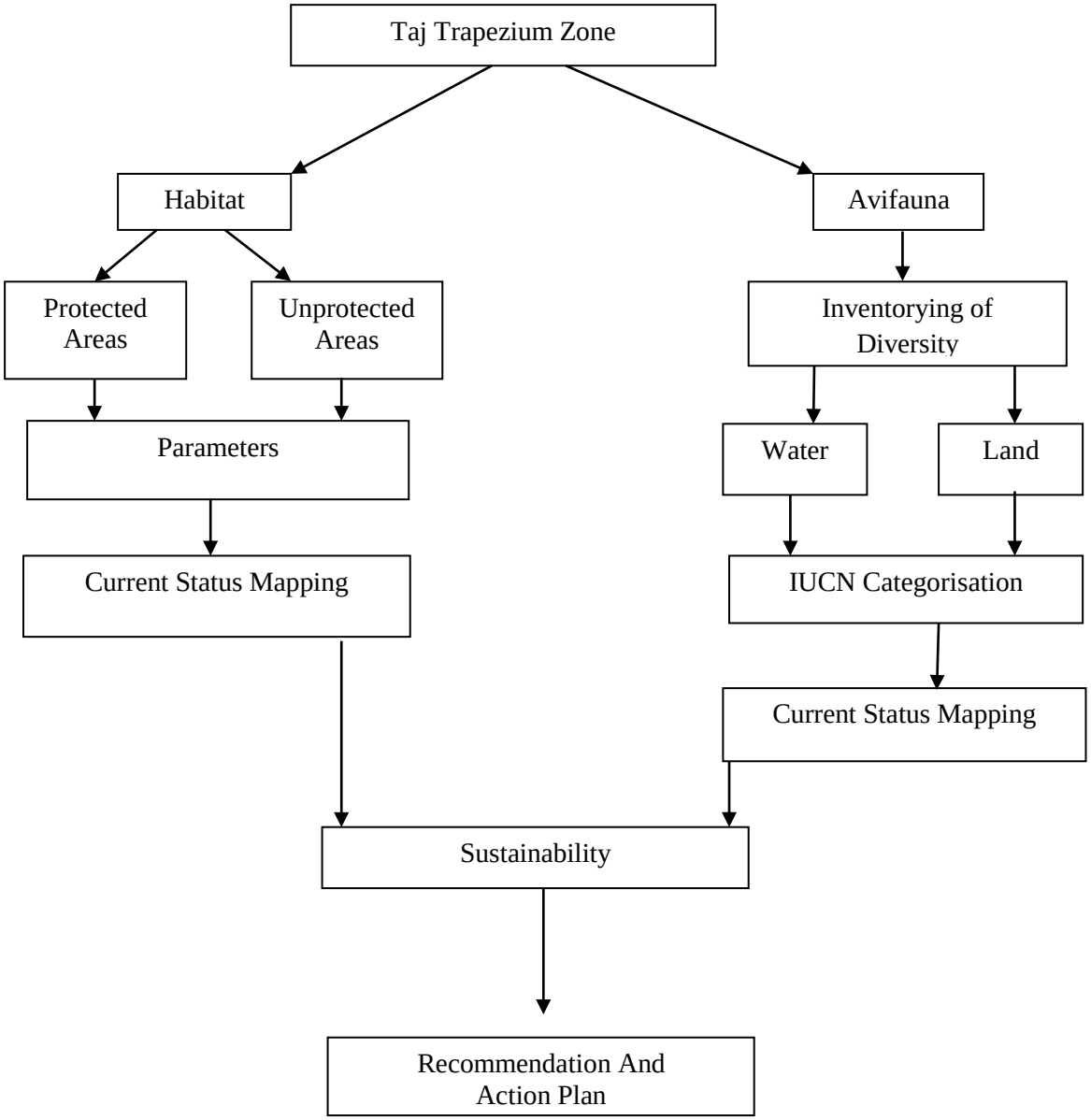
N= total individuals of all species

- **Relative diversity:**

$$\frac{\text{Total number of Species in a family}}{\text{Total number of Species}}$$

- Updated relevant Software will be utilised for Data analysis.
- Remote sensing and GIS will be done with the help of Indian Institute of Remote Sensing at Dehradun.

Plan of work



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